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COMPLEXITY AND MILITARY STRATEGIC THOUGHT
BALANCING ORDER AND CHAOS
Core Course 5 Essay

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"We have it in our power to begin the world over again" Thomas Paine

Today's complex, interdependent global community has been thrust into a period of discontinuity, rapid change and uncertainty. No longer able to predict future events with any degree of certainty, countries are desperately searching for new and innovative strategies to match limited means to ambiguous ends. This is especially true for the United States, which has been profoundly affected by two major events.

The first major event affecting strategy is the *transition* the United States is currently undergoing from the industrial age (Second Wave) to the information age (Third Wave).¹ The economy of Second Wave industrial mass production with its homogeneous society is being replaced by a Third Wave brain-based information and service economy with a heterogeneous society. The "information age" is providing the U.S. and its military a quantum leap advantage in advanced technology, information systems, and innovative ways to exploit knowledge. However, it is also creating a more fragmented society with a plethora of special interest groups, significantly increasing the complexity of organizational interactions. This fundamental shift in the way the United States conducts its affairs, both internationally and domestically, profoundly affects every dynamic system (for example, political, economic, military, or environmental) the country interacts with across the full spectrum of the globe. It is changing the very nature and conduct of war.

The second major event impacting strategy is the collapse of the Soviet Union. No longer in a stable, bipolar world, the United States and the global community have been

¹ Alvin and Heidi Toffler, War and Anti-War (Boston: Little Brown and Company, 1993) 22-23

thrust into a state of uncertainty, ambiguity, and instability The United States and the rest of the world are now in a *transition* phase between Cold War world “order” and post-Cold War “chaos ” This transition, like the Second Wave to Third Wave transition, also affects every dynamic system the country interacts with and fundamentally affects U S military strategic thought These two events, together with drastically reduced budgets, fundamentally have changed the landscape upon which the country’s national security and military strategies are based

Our military strategy must be able to adapt to these “transitions” and at the same time cope with current fiscal and global realities In this era of reduced defense spending and increased worldwide military commitments, the gap between means and ends continues to expand Matching diminished means to ambiguous, ever-increasing ends while minimizing risk is no easy task and gets more difficult with each passing day New ideas are needed Perhaps a whole new and innovative approach to strategic thinking will provide a different perspective to the problems now facing the strategist

This paper proposes just that, a nontraditional approach uniquely designed to explain systems thinking concepts of discontinuity, transition and adaptation It does so in a way that may help the strategist comprehend problems more clearly and in turn provide innovative solutions It will show that discontinuities are inevitable, unpredictable, and that seemingly small events can lead to catastrophic outcomes It will also explain that due to these discontinuities, actors will change and make adaptations This in turn will effect in some way all the other actors, starting another sequence of change and

adaptation This explains that the only “certainty” a strategist has is that *everything is unpredictable*

United States military strategic thought is currently undergoing a *transition* from “order” to “chaos,” attempting to adapt its dynamic systems (organizations) to the tremendous changes brought about by these two revolutionary events This is a very difficult task, trying to make sense of the uncertain, chaotic future and develop a strategy to deal with it Because many of the traditional Cold War threats no longer exist, most of the actors have changed their interests, objectives, policies, and the way they interact in the global community In fact, they are also in the midst of transition Additionally, there are many new players in the game who do not necessarily know, or play, by the rules In essence, current military strategy is trying to manage the “chaos” it has found itself engulfed by Perhaps U S military strategists should not simply attempt to manage the chaos, but instead attempt to ensure chaos is never achieved It may be better in fact to remain in the “transition” phase, never fully reaching order or chaos Strategists should therefore focus on steadily managing the “transition” by balancing order and chaos

Transition, that is, changing from one state to another (order to chaos), in the context of military strategy is a complex, nonlinear process affecting many actors (dynamic systems) The increasing complexity of military affairs forces the military from interacting in the realm of traditional actors (armies, navies, and air forces) The military now finds itself in a more complex arena involving such actors as other U S government agencies, multinational corporations, religious fundamentalists, NGO’s, terrorist groups and many other political, environmental and ethnic groups In addition, the issues the

military must deal with are no longer strictly military related but now include economics, politics, religion, the environment, the list goes on

Fortunately for the strategist, there is a relatively new science that deals precisely with complex dynamic systems undergoing transition from “order” to “chaos ” This new science is called Complexity Science It attempts to explain the dynamics and interactions complex systems experience while undergoing order-to-chaos transitions Complexity science also demonstrates that somehow all these complex systems remain amazingly balanced between order and chaos, constantly moving back and forth between the two, always seeking out the best position The systems never reach chaos, instead they remain focused around a balance point between the two states This balance point, called “the edge of chaos,” is where the components of a system never quite lock into place (order), but never quite develop into turbulence (chaos), either It is most accurately described as follows

“The edge of chaos is where new ideas and innovative genotypes are forever nibbling away at the edges of the status quo, and where even the most entrenched old guard will eventually be overthrown The edge of chaos is the constantly shifting battle zone between stagnation and anarchy, the one place where a complex system can be spontaneous, adaptive, and alive ”²

As it pertains to military strategy, complexity science offers a fresh new insight into the process of transitioning from Second Wave, Cold War “ordered” strategy to Third Wave, post-Cold War “chaotic” strategy It provides the strategist a new perspective on discontinuity, change and adaptation It is a concept that deserves a hard look, as it may

² M Mitchell Waldrop, Complexity (New York Simon and Schuster, 1992) 12

be the tool in the strategist's box that makes the difference in this unpredictable, forever changing world of uncertainty

Complexity science, according to Santa Fe Institute founder George Cowan, is one of the new sciences of the twenty-first century. It is a science about complex, nonlinear dynamical systems.³ It is an interdisciplinary science that uses elements of various other sciences, including biology, mathematics, economics, ecology, artificial life, physics and chaos theory. It is an alternative to the reductionist, linear thinking that has dominated science since the time of Newton.⁴

Complexity science deals with systems that are complex, in the sense that a great many independent actors are interacting with each other in a great many ways. An example would be all the trillion upon trillion interconnected water molecules that make up an ocean. The systems must also be dynamic, in that they change (transition) or adapt during their interactions, constantly seeking self-improvement or mutual accommodation with other systems in the environment. In a way, these systems exhibit self-organization (explained later). They somehow make decisions based on their various interactions, atoms seeking minimum energy states by forming molecules, genes developing into specific cells, or militaries organizing hierarchies to simultaneously perform across a range of operations.

Complexity theory, as noted earlier, is based upon a combination of elements from several sciences. These elements, taken in various combinations and forms, provide the

³ Another outstanding source for 'systems thinking' is Peter M. Senge's The Fifth Discipline (New York: Doubleday, 1990). Chapter 5 provides an exceptional explanation of complexity as it applies to systems thinking.

⁴ M. Mitchell Waldrop, Complexity (New York: Simon and Schuster, 1992) 13.

substance to build the concepts that provide the foundation to the theory. Three main concepts, *self-organized criticality*, *phase transitions*, and *coevolution* provide key conceptual ideas behind complexity theory. A basic understanding of these concepts is necessary in order to appreciate the innovative insight the theory brings to the strategist and how it may be applied to military strategy now and in the future.

Self-organized criticality is about discontinuity. Perhaps the best way to describe this concept is to use physicist Per Bak's sand pile metaphor.⁵ Imagine a small pile of sand on top of a table and a slow but steady sprinkle of sand falling on it from above. The pile continuously grows, old sand sliding down the side as new sand accumulates on top, until it can not grow anymore. In the sense that the sand pile reaches this state without the explicit help from an outside actor, it is said to be self-organized. But, it is also in a state of criticality, in that the grains of sand on the surface are just *barely stable*.

So what happens when the next grain of sand falling from above hits the pile? The surface grains are interlocked in an infinite number of combinations and ready to give at any time, so there really is no way to predict that. Perhaps nothing happens. Maybe just a few sand grains will shift a little. Or maybe, it leads to a catastrophic landslide that wipes away one whole side of the sand pile. According to Bak, over time all these things will occur. Small shifts, or readjustments, are frequent while large avalanches, or catastrophic events, are rare. The fact is, these events will happen. If not now, *unpredictably* in the future.

⁵ M. Mitchell Waldrop, *Complexity* (New York: Simon and Schuster, 1992) 304.

An interesting spin-off from criticality is it demonstrates that small, seemingly insignificant events can lead to major changes in future outcomes, perhaps even with catastrophic results. Remember, just one small grain of sand dropped at the right spot can create a major avalanche. In the realm of military operations, one small, seemingly insignificant event while conducting a relatively benign MOOTW could possibly lead to an MRC in the future.

The sand pile metaphor describing criticality can apply to any complex dynamical system. A steady input of energy into a system will drive that system to self-organize, eventually reaching a point of criticality. The system essentially becomes an aggregate of “intricately interlocking subsystems just barely on the edge of criticality--with breakdowns of all sizes ripping through and rearranging things just often enough to keep them poised at the edge.”⁶ This is where discontinuity exists, right at this edge of criticality, most being small shifts, or readjustments. However, the rare catastrophe is also possible. For the strategist this means he must know that discontinuity will occur, unpredictably sooner or later, forcing a change in strategy. For a strategy this means that it must be constantly reassessed and changed.

The second concept of complexity theory, phase transitions, is about change. When a system undergoes a change from one state to another, it does so via a process known as transition. The classic example deals with matter, solids transition to fluids. This is exactly what happens in dynamical systems, order transitions to chaos. In the case

⁶ M. Mitchell Waldrop, Complexity (New York: Simon and Schuster, 1992) 305

nonlinear dynamics, though, transition is phrased “complexity” The reason being the nature of the transition, it is fundamentally different

There are two types of transitions in nature, first-order phase transitions and second-order phase transitions First-order phase transitions are the type most people are familiar with They apply to matter transitions and are linear, definitively changing matter from one state to another For example, if heat is applied to a piece of ice and its temperature increases past 32 degrees F, the ice changes to water It happens all at once, the molecules are basically forced to make an either-or choice between order and chaos Any molecules below the boundary are moving slowly and make the “decision” to solidify (order) Conversely, molecules above the boundary are moving too fast to solidify, so they “decide” to be water (chaos) These transitions are defined and exact, occurring on thin boundaries (in this case, precisely at 32 degrees F)

Second-order phase transitions, in contrast, are not well defined, pertain to dynamical systems and are nonlinear They drive systems to *equilibrium* between the two states These transitions do not require system components to make either-or choices nor do they occur all at once However, like first-order phase transitions, the boundary (edge of chaos) is an infinitesimally thin barrier separating order and chaos It is precisely at this “edge of chaos” where order and chaos are balanced As the components of a system transition from order to chaos, they begin to slowly transform into the chaotic state, comprising both order and chaos at the same time At any given time, a system component can exist in any varying degree of both “order” and “chaos” In fact, while in the transition phase, the system components can shift back and forth from being more

“order” to more “chaos” and vice versa. Those components closer to the “order” state will exhibit proportionately more ordered characteristics while those components further along in the transition and closer to “chaos” will exhibit more chaotic behavior.

Second-order phase transitions, then, provide the “edge of chaos” for order and chaos to “intertwine in a complex, ever-changing dance”⁷ of system components in varying degrees of order and chaos. Constantly shifting back and forth between order and chaos, systems are adapting. Systems are making decisions and influencing other systems. This is where change takes place. Nothing here rests. For the strategist this means he must be able to adapt to this “ever-changing dance” between order and chaos. More importantly, for the strategy it means it must once again be readily adaptable.

The third concept, coevolution, is about adapting. It is about systems constantly trying to adapt to all the others, a good analogy being natural selection. Natural selection can be thought of as a transition from one state of being to another, more advantageous state of being. It is important to stress that it is not just a change to another state of being, but a change that puts it at an *advantage* over the state from which it changed.

To visualize this concept, imagine a species free to mutate and evolve by natural selection and interacts with other species only in specific ways. For example, a hawk depends on its ability to swiftly swoop down from above to capture its prey. Suppose the hawk evolves an aerodynamically improved wing, enabling it to swoop down even faster. This will force the prey to learn how to escape faster. Or perhaps, the prey evolves an internal chemical that makes it have a repugnant taste to the hawk. This forces the hawk

⁷ M. Mitchell Waldrop, Complexity (New York: Simon and Schuster, 1992) 230.

to either adapt to the intolerable taste or evolve an ability to neutralize the chemical. This coevolution and adaptation will continue throughout the process of natural selection, with each species continually seeking out a better advantage.

Each mutation, evolution, and adaptation cycle brings about new strategies to deal with the changed situation. All the strategies taken together, be it "prey catching" strategies for the hawk or "hawk evading" strategies for the prey, determine the "fitness" of the species. If the hawk has better strategies, it is at an advantage and can be considered more "fit." The same applies to the prey.

The point of coevolution is this: the environments in which systems interact, be it a species of animal in the ecosystem or an organization in the global community, are not independent. What one system does in its environment affects other systems in that environment and perhaps systems in other environments. Remember, systems adapt to advantage themselves. This in turn affects strategies. Going back to the example of the hawk and prey, what is a good strategy for the hawk depends on what the prey is doing, and vice versa. To demonstrate system environmental interdependence, consider what happens if the prey has a much better strategy than the hawk and overpopulates. Too many rodents could effect the local human population as they infest peoples' homes in search of food. That could possibly lead to field burning, resulting in air pollution and so on and so forth. There is a sort of interconnectedness about it all. Each adapting system affects other systems, sometimes only minimally and other times to some greater extent. Sometimes disastrously. The possibilities are endless.

Not knowing precisely how systems will adapt and how strategies will change gives rise to uncertainty, an area in which strategists are uncomfortable. Strategists like situations to be certain, it lets them predict things like actions, reactions and effects. Unfortunately, uncertainty must be confronted. For the strategist this means he must be sensitive to the nature of uncertainty and prepared to deal with any possible outcome. For the strategy it means unpredictability will be the norm.

The challenges and opportunities of today and the future are tremendous. The United States and the global community are no longer in a world of "order," but instead in a fluctuating state of "chaos." The complex, interdependent systems of today need new and innovative approaches to solutions of the difficult, interconnected problems of today *and* tomorrow. If answers are to be "long term solutions" vice "short term fixes," then strategists must think in terms of complex systems dynamics and nonlinearity, which is the nature of the world today.

Complexity science gives the strategist an opportunity to better understand this nonlinear, complex systems dynamics. It provides a basis to perhaps comprehend why discontinuities are unpredictably inevitable and that insignificant events can possibly result in future cataclysmic outcomes. Complexity science also explains that systems will *change* and *adapt* to their environment, affecting all other systems in uncertain and unpredictable ways. More importantly, though, it gives the strategist and his strategies a new direction, one which consists of not attempting to manage "chaos" but managing "the edge of chaos."

"I am convinced that the nations and people who master the new sciences of complexity will become the economic, cultural, and political superpowers of the next century." Heinz Pagels, physicist